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*Errata:*

The article “Effect of treadmill training on blood pressure among young adult boys”, authors Gaurav Dureja, Sukanya Bardhan, published in *Medicina Sportiva* vol X, No 3, was retired at the request of the authors.

## Ethical issues and doping in Olympic and Paralympic Games

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**Abstract.** The diffusion of doping is caused by psychological and social dynamics. If the guys believe that the capacity is not related to commitment, then they are more exposed to the use of performance-enhancing drugs. There are three categories of reasons that induce athletes to use performance-enhancing drugs too: causes psychological and emotional, social and psycho-physiological. Moreover, in literature you can read other reasons that push people to take drugs: the “effect of formulation”, the “principle of utility”, the “heuristics of the accessibility” and the “representativeness heuristic”. Doping exists not only in professional sport but also affects amateur athletes. It poses a threat to sport worldwide. To use substances or resort to methods that may artificially alter the capabilities is ethically and legally wrong. The main ethical issues related to gene doping are also found in their detection that involves tissue sampling. There is a risk for the future generations, too. Moreover, the modification of DNA could lead to the creation of new and unknown viruses. Another problem related to ethical is the use of the prosthesis by disabled athletes. Also, in the case of “boosting” the athletes don’t taking performance-enhancing drugs, they don’t commit any offence, so this practise is not prohibited by WADA. Furthermore, the use of implants, the “technodoping”, and their additional benefit, is another ethical issue. The focal point shouldn't be an athlete's disability, or the technical support they get, but their talent and their willpower. Also, various arguments are spreading in support of liberalization of doping. Some are based on the circumstances that currently the values of equality and health are not protected and, therefore, the liberalization of doping doesn't result in a change in the current situation. Indeed, according to others, the attitude prohibitionist involves the search for substances and methods of administration increasingly dangerous such that the liberalization entails a greater control and a greater spread of "safe" substances.

**Keywords:** *ethics, doping, disabled athletes, gene doping.*

### Introduction

Doping exists not only in professional sport but also affects amateur athletes who are making increasing use of performance-enhancing drugs (1-3). Definite doping agents or doping methods can improve specific aspects of physical performance in athletes in Olympic and Paralympic Games.

Doping poses a threat to sport worldwide. It undermines the principle of open and fair competition (3,4). It is a factor that discourages the practice of sport in general and puts the professional under unreasonable pressure. It seriously affects the image of the industry and represents a serious threat to individual health (1,3,4). One of the reasons that pushes athletes to take drugs is money: to win a competition means to make money, employment contracts and fame (5).

The use of performance-enhancing drugs is also justified by the desire to keep fit or improve physical appearance. According to the 2010 report

of the Italian National Bioethics Committee, the diffusion of doping is related to psychological and social dynamics such as the speeding up of life in industrial societies, the anxiety to improve performance, the fear of not being able to deal with the problems of everyday life. But the use of drug is also justified by the desire to fully enjoy free time.

Indeed, the study conducted by the said Presidency shows that some athletes tested positive for cocaine in order to "get high" in the disco after a sports competition (6). Nicholls argues that to understand why an athlete takes performance-enhancing drugs you have to search for the reason why he does sports (7).

The author emphasized that the guys around 12 years old can play sports for two main reasons: because they are oriented to the task or because they are oriented to the ego. The starting point of the theory of Nicholls lies in the consideration the guys have the commitment.

If they, indeed, believe that engagement is important for the attainment of success, then they will belong to the first category - orientation to the task - as if the guys believe that the capacity is not related to commitment, then they belong to the second category - ego orientation. The "task-oriented" have high self-esteem and try to conquer success only by engaging more in the work he carried out, and for that reason they have a low propensity to doping. In different way, those who are ego-oriented have a low self-esteem and try to excel over others anyway. To these people don't care to improve themselves but just the win. Therefore they are more exposed to the use of performance-enhancing drugs. In scientific literature, major emphasis is placed on doping detection, the use of drugs that can improve selective aspects of physical performance and whereas detrimental effects of doping agents on athlete's health are seldom discussed (8).

Messina M (2006) has also identified three categories of reasons that induce athletes to use performance-enhancing drugs: causes psychological and emotional, social and psychophysiological. One of the first reasons is to include the fear of failure, excessive tendency towards competition, the search for the perfect result and victory. Among the social causes, you can be found the will to emulate professional athletes, the pressure of the various stakeholders. Among the latest cases, there is the need to reduce the pain, the early rehabilitation, the increase energy and the control the changes of your body (9).

Kahneman and Tversky (10,11) demonstrate how people, opting for the opposite choice than rationally most logical. In case of doping, for example, the rational logical choice is to not take drugs, but in spite of that, faced with this choice, many dope!

This tendency to irrational choice is explained by four factors. The first is the "effect of formulation" that is the way it is worded message: in the case of doping is worded the message that doping leads to higher benefits against minimum costs. The second reason is the "principle of utility" with which a person tends to focus its attention only on the benefits that doping can give and not on the negative aspects. Another fact is the "heuristics of the accessibility" with which you tend to overlook the possibility that an event occurs because, for example, has never seen it in its social context. In the case of doping, usually, those who fall ill tend to "bow out" and, therefore,

young people do not know, because they don't attend, the negative effects of doping. The last factor is the "representativeness heuristic" with which you tend to emulate an idol, ignoring, for example, that athlete has achieved specific results fraudulently (10,11).

In this time, a lot of media focused the attention around the problem that the doping, and in particular the gene doping, could change forever the sport. The competitions will be won by the most doped athletes rather than those most deserving (12).

This phenomenon, of course, poses serious healthy and ethical problems (12,13). Doping, indeed, causes health risks and it violates the spirit of sport (2). One of the main values to protect is the equality: all athletes must compete and win competitions only thanks to their natural abilities. The use substances or resort to methods that may artificially alter the above capabilities is ethically and legally wrong (14)

The first general ethical question to resolve poses for the physician who must administer performance-enhancing drugs or genes to a patient / athlete. The question is whether the medical treatment has a greater effect on the person or on the athlete? and in this second case, it may prohibit the athlete to undergo medical treatment only because they could lead to an improvement of the performance (5)?

The solution is given by the World Anti Doping Agency (WADA), which expressly prohibited the participation in competitive sports by the athlete in case of taking banned substances to treat disease in the event that the above assumption implies an excessive improvement of performance.

It reads, in fact, art. 2 of Guidelines - Therapeutic Use Exemptions (TUE) "*An Athlete may be granted a TUE if (and only if) he/she can show that each of the following conditions is met:[...] b) The Therapeutic Use of the Prohibited Substance or Prohibited Method is highly unlikely to produce any additional enhancement of performance beyond what might be anticipated by a return to the Athlete's normal state of health following the treatment of the acute or chronic medical condition (ISTUE Article 4.1(b)). Although there may be some enhancement of individual performance as a result of the efficacy of the treatment, nevertheless, such enhancement must not exceed the level of performance of the Athlete prior to the onset of his/her medical condition*" (15).

Data obtained from a meta-analysis on the major search engines online - PubMed, Google and Google Scholar - and the material posted on institutional websites of World Anti-Doping Agency, International Olympic Committee and International Paralympic Committee. The search terms were the follows: doping, ethics, autonomous dysreflexia, disabled athletes.

### **Ethics and Gene Doping**

In the course of time, doping has shown a great ability to discover and always use new substances and appropriated the new scientific discoveries (1,13).

Actually, a new frontier reached by the doping is the use of genes. It is, in essence, to use the results obtained in the medical field regarding the use of genes for therapeutic purposes and to use them for purposes far less noble. In this regard, it is said that gene doping is an outgrowth of genetic therapy. Unfortunately, the increase in discoveries of new substances and new methods of doping is not associated with an equally increased awareness of the many health risks with taking the above substances or the subjection to these methods (5,13,16).

At the same time in which scientific research discovered the human gene map, the industry of doping was trying to steal those new knowledge in order to commercialize them (17).

The main ethical issues related to genetic doping are also found in their detection that involves tissue sampling (18-19). It will be unlikely that athletes can be forced to give consent to this procedure given the invasive nature of the biopsies necessary to submit (19). Furthermore many forms of genetic doping do not require the direct injection of genes in the desired target organ. So, the subjection to the very invasive examinations clashes with the need to identify the genetic modification. (17).

In the near future, Miah A. assumed cost reduction for mapping genes (17.) This could encourage people to request the mapping of own DNA in order to diagnose possible diseases in time. This possibility, if on the one hand would represent an important target for the prevention and treatment of disease, from the another hand, it could create an erosion of privacy (17).

Unfortunately, genetic manipulation you could imagine a future of genetically modified athletes who participate in competitions which are divided according to the modified genome, then using a criterion similar to the division of the Paralympic

athletes. We'll be looking at a future where artificial competitions will be not won by athletes most deserving but more "artifacts" (17).

Moreover, currently we don't know the long-term effects of the use of genes: in particular there is a risk that the modification of the body through the use of gene therapy may also have an impact on future generations. If the person genetically modified is the parent of an athlete, what consequences it could have for the son? There would be an athlete who, not intentionally, has an altered DNA that has artificially improved their performance (17).

In this case, the ethical question is obvious: the athlete may be sanctioned or excluded by sporting events due to his changed DNA even if he has not done anything? What will be, therefore, the response of sports authorities to this problem? (17). fortunately, at present, there are no answers because sports and government authorities have not enough knowledge about the possible problems related to the access of the genes from the population (17).

In addition, another ethical and health problem lies in the possibility that the modification of DNA could lead to the creation of new and unknown viruses. Thus, the problem is not only related to health of athletes but the entire population (14).

Another question is related to individuals with impaired function of the androgen receptors. These are people who by birth and outwardly female but genetically male. They, therefore, have a level of androgen hormones typically male acting especially in the muscles. This condition is similar to those athletes who voluntarily take androgens. The main difference is that in the former case there is no will to exceed on the type of hormone, because it is a pathological condition, while in the second case it is clear the intent to deceive. There are various arguments that clash on the issue. According to the first argument, the case does not involve any breach of the WADA code because it punishes the penetration of prohibited substances in the body. According to another theory, if the condition of the athlete is known before the competition she should not be allowed to compete. If she participates, she should be punished like a doped subject. Against this last thesis have raised the voices of those who believe that the exclusion from the competition would be contrary to the values of sport as it would be to penalize a person who has no fault of their own genetic structure.

The problem, nevertheless, is found in the fact that an athlete female but with an excess of androgens has a natural advantage over other athletes, as if she was doped (6).

The problem is not easy to solve because there are few cases that have occurred. From time to time the responses are different. For example, in the 70s the Finnish cross-country skier Eero Antero Mäntyranta was accused of doping because his blood contained about 30% more red blood cells, but after careful analysis also about his family, it was found that this concentration was due to a natural genetic mutation that produces the hormone EPO. Therefore, he was acquitted of all charges for not having taken any banned substance. (20).

### **Ethics and Disability**

In competition with disabilities, there is another way to cheat: it is commonly called "boosting". With this term sports institutions and mass media refer to self induction of Autonomic Dysreflexia (AD). The AD is a well-known clinical emergency that affects people with a high-level spinal cord injury (T6 and above) but the athletes voluntarily causing the above condition in order to enhance their performance. The way in which disabled athletes cause AD consists in inflicting pain on themselves in the parts of the body below the lesion, where they have not the perception of pain (21,22). The main reason for which those athletes cause themselves the syndrome is found in the fact that during training and competition, the dysreflexic state actually reduced the rating of perceived exertion for pushing, and faster top speed (23). The problem of boosting is emerged in a clear manner in the 1996 at the Paralympic Games in Atlant. Since that time, the Committee raised the question of how he could intervene. The problems were mainly ethical.

The first problem is related to controls. Craig Spence, 2012 spokesman of International Paralympic Committee, in fact, said that the checks can only be performed on athletes who have clear symptoms of the said disease, as red-faced or excessive sweating and you can do perform a blood pressure check. Unfortunately, however, there is a major limitation: you cannot ask athletes to undress to see if they have used the laces to crush the testicles or legs, or if they broke the bones of the feet, for example.

Ethical problem concerns if 'boosting' is considered a doping method or not. Prestigious

researchers, like Craig P Hunter, and mass media support the first thesis.

But, at present, according to the sports institutions the "boosted" athletes, don't taking performance-enhancing drugs, don't commit any offence! So, the boosting, although is a method used to improve performance and therefore comparable to the doping methods banned by WADA, it is not prohibited by that Agency (24). Indeed, an athlete with obvious symptoms of the AD, will not be subjected to any penalty, since he will not have committed any type of offense (25). "*The IPC forbids athletes to compete in a hazardous dysreflexic state*" only because the primarily goal to protect the health of athletes (26).

Instead, the use of the prosthesis, for example in the case of limb amputations, that is called by mass media "technodoping", added an ethical issue. The question is whether those implants can give an unfair advantage to the athlete during competition (27).

A lot of researches have been conducted to a clear result: an athlete who wearing the "Cheetah prosthetic" could run at the same speed as able-bodied athletes but use less energy. The tests also revealed that running with prosthetic blades led to less vertical motion combined with 30% less mechanical work for lifting the body (27). The International Association of Athletics Federations (IAAF), decided to ban the use of each instrument - including implants - that would give an advantage to the athlete. The problem, then, is whether this prohibition protects the able-bodied athletes in front of the advantages that implants can give disabled people or if in fact, you are faced with a real case of inequality against people with disabilities (28).

In 2008, the topic "Elite Paralympic Sports Facing New Challenges", was discussed by experts in the field. in Beijing.

It was emerged in clear manner that the decision of exclusion of the above mentioned athletes by the able bodies competitions, is not limited to the sport itself, but is ethically and morally relevant under the aspect of equal opportunity. Prof. Dr. Gudrun Doll-Tepper, president of the International Council of Sport Science, said that those people are unique and and therefore not comparable to those without disabilities.

At the root of the problem, is the vagueness of sports institutions in addressing the issue of the benefits gained by the athletes during the competitions. In particular, it has not been

analyzed whether the advantage of an athlete with implants is equal or not to the other benefits provided to other athletes (29).

### **Thesis pro liberalization of doping**

There is who is in favor of liberalization of doping in sport. The reasoning behind this minority argument are essentially two. It starts, first, on the assumption that the values to protect are the equality of the athletes and their health. Supporters of this thesis believe that at present the above values are not fully protected. In fact, equality is not protected in view of the fact that not all the athletes can afford economically best coaches. In addition, athletes' health is at risk every time they undergo special physical exercises.

Therefore, given that not all athletes can economically afford to buy performance-enhancing drugs and that the above-mentioned substances can be potentially harmful to health, the liberalization of doping does not involve a change of the situation described above. (5)

*"By allowing everyone to take performance enhancing drugs, we level the playing field"* is the slogan of Savulescu J et al. , who have proposed the liberalization of biotechnologies in sports in order to allow a leveling among those who by nature are advantaged and those who, instead, have to resort to artificially same results. You would like that, really, competitions between athletes alike! (30). They point out that the Olympics are a real business and that only money buys success. Therefore, with the liberalization of doping you have the elimination of discrimination between rich and poor athletes. Currently, another existent problem is that athletes are looking for new performance-enhancing drugs undetectable by the controls. These substances can be harmful to their health. Therefore, another reason to liberalize doping is just to allow the athletes to use "safe" performance-enhancing drugs, eliminating in this way the above problem (31). Breivik G. (2005) believes that if doping is difficult to defeat, then, in order to ensure greater equality in competitions it would be necessary to give everyone the possibility to take drugs (32). Brown W.M. (1980) taken a positive approach to doping, too. In fact, he believes that it is necessary to disseminate information not only negative, but also positive on the positive effects of doping leaving, then the athletes the ability to choose (33).

### **Discussion**

Money, contracts and fame lead some athletes to take drugs (5). There are certain drugs that can improve selective aspects of physical performance (8). But there are also deeper reasons that push athletes to undergo this practice illegal and harmful to health. Nicholls believes that an ego orientation has low self esteem and tries to get approval in every way, even resorting to doping (7). Messina, meanwhile, says that there are causes psychological and emotional, social and psycho-physiological (9).

Gene doping has used scientific discoveries in the medical field and used them for non-nobles. In addition to the legal issue, gene doping raises a number of ethical problems. The first concerns its detection. In fact, it consists in biopsies that are too invasive for athletes (18,19). The second problem concerns the possible new diseases that could arise in GM's body and that of future generations (17). If, then, athletes born with a modified DNA caused by artificial alterations the DNA of their ancestors, you can forbid them to participate in the competition? On closer inspection, these people have not committed any offense (17). Typical, for example, in the case, women with impaired function of the androgen receptors. These women have a typically feminine appearance but an abnormal production of androgens which makes them, in the performance of men. The problem in this case is whether it is right or not to exclude them from competition with other women just because of this natural condition.

One more question be reckoned with is closely related to autonomic dysreflexia, which is a known clinic emergency that affects people with spinal cord injury at T6 or above (21,22). In sports, the disease is self-induced as it triggers a series of reactions in the body such as to enhance performance. It is, unfortunately, very seriously dangerous for sufferers (23). The problem with this situation - that in the sports field takes the name of boosting - is that, although it is commonly considered as a doping method, it is not officially considered doping. Therefore, the self infliction of suffering below the lesion, where the athlete has no sensitivity to pain, in order to provoke the above mentioned pathology, is not penalized as doping. The athlete who has the typical symptoms of the aforesaid condition is removed from the competition only for health

reasons and will not be punished because they do not have violated any anti-doping rule.

Therefore, the ethical issues related to boosting are not even addressed (24). It seems, almost, that the world of sport "secular" has already given with respect to the establishment of sports. Some ethical questions are based on the circumstances that currently the values of equality and health are not protected and, therefore, the liberalization of doping does not result in a change in the current situation (5,30). Indeed, according to others authors, the attitude prohibitionist involves the search for substances and methods of administration increasingly dangerous such that the liberalization entails a greater control and a greater spread of substances "safe" (31).

Today, the sports institutions appear to be related to "classic" ethical problems and still can not provide answers to new and more complex briefly mentioned In this essay. Surely the ethical problems are closely linked to technological advances and the use of new scientific discoveries in the field of sport and, therefore, are likely to increase and become more complex. is necessary, therefore, to start giving adequate answers to more pressing issues that can not be ignored. It is hoped, therefore, to re-examined the same issues in a future essay, providing the reader with the most comprehensive answers.

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#### References

1. Anti Doping Convention (1989). From <http://www.coe.int/t/dg4/sport/doping>
2. Lippi G, Longo UG, Maffulli N (2009). Genetics and sports. *British Medical Bulletin*; 93: 27-47.
3. Pérez Triviño J. L (2011). Gene Doping and the Ethics of Sport: between Enhancement and Posthumanism. *International J. of Sport Science*; 1(1): 1-8
4. European Group of Ethics, Ethical aspects arising from doping in sport (1999). from [http://ec.europa.eu/bepa/european-group-ethics/docs/avis14\\_en.pdf](http://ec.europa.eu/bepa/european-group-ethics/docs/avis14_en.pdf)
5. Oliveira RS, Collares TF, Smith KR, et al. (2011). The use of genes for performance enhancement: doping or therapy? *Braz J Med Biol Res*; 44 (12): 1194-201.
6. Presidenza del Consiglio dei Ministri – National Bioethics Committee (2010). Ethics, Sport and Doping, 25 March. 1-20. From: <http://www.governo.it/bioetica/eng/pdf/dopng.pdf>.
7. Nicholls J. G. (1992), The General and the Specific in the Development and Expression of Achievement Motivation. In *Motivation in Sport and Exercise*. Roberts GC (eds). Human Kinetics. Champaign; 31-56
8. Birzniece V (2014). Doping in sport: effects, harm and misconceptions. *Intern Med J*; Nov 5. doi: 10.1111/imj.12629.
9. Messina M (2006). Gli aspetti motivazionali all'uso di sostanze dopanti. In *Doping, aspetti medici, nutrizionali, psicopedagogici, legali ed etici ed indicazioni per la prevenzione*. Regione Veneto (eds); 99-112
10. Kahneman D, Tversky A (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*; 47(2): 263-91.
11. Tversky A, Kahneman D (1974). Judgment under Uncertainty: Heuristics and Biases Science. *New Series*; 185 (4157): 1124-31.
12. Filipp F (2007). Is science killing sport? *European Molecular Biology Organization*; 8(5):433-5. From: <http://embor.embopress.org/content/embor/8/5/433.full.pdf>
13. Santamaria S, Ascione A, Tafuri D, Mazzeo F (2013). Gene doping: biomedical and law aspects of genetic modification of athletes. *Med Sport*; 17(4): 193-9.
14. Haisma HJ, de Horn O, Vorstenbosch J (2004). *Gene Doping, Netherlands Centre for Doping Affairs*, Capelle aan den IJssel; 1-36
15. Guidelines - Therapeutic Use Exemptions (TUE). From <https://www.wada-ama.org/en/resources/science-medicine/guidelines-therapeutic-use-exemptions-tue#.VGCFdqXtozX>
16. Unal M, Ozer Unal D (2004). Gene Doping in Sport. *Sports Med*; 34: 357-62.
17. Miah A (2012). Genomics & Sport: Bioethical Concerns. *Recent Patents on DNA & Gene Sequences*; 6 (3): 197-202.
18. Fedoruk MN, Rupert JL (2008). Myostatin inhibition: a potential performance enhancement strategy. *Scand J Med Sci Sports*; 18:123-31.
19. Friedmann T, Flenker U, Georgakopoulos C et al. (2012). Evolving concepts and techniques for anti-doping. *Bioanalysis*; 4: 1667-80.
20. Green RM (2007). *Babies by design. The ethics of genetic choice*. Cap. I: Creating the Superathletes. Yale University Press. New Haven.